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IRRIGATING TOBACCO

Farmers' Bulletin No. 2159

U.S. DEPARTMENT OF AGRICULTURE

This publication discusses the general principles of irrigating tobacco. Problems peculiar to tobacco types or to geographic areas are not discussed. It is possible that advice given in this publication differs from that given by specialists familiar with tobacco production in your area. In that event, follow recommendations of local specialists.

You can get advice from the Soil Conservation Service office or the agricultural Extension Service office in your county, or from your State agricultural college.

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IRRIGATING

TOBACCO

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In years when rainfall is so low that the tobacco crop would normally fail, an irrigation system can be used to produce an average yield of high-quality leaf (fig. 1). Even in years when rainfall is high—but poorly distributed—an irrigation system can be used to apply water at crucial stages of growth to increase yield and improve quality.

In irrigating tobacco, as in irrigating other crops, time and amount of water application are important. Applying too much or too little

***Figure 1.*—Growth of irrigated and nonirrigated tobacco in these adjacent plots shows the difference irrigation can make in a dry year. (Courtesy of University of Maryland.)**

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water, or applying it at the wrong time, may reduce rather than increase profits.

Water management is especially critical on soils that have poor internal drainage. Heavy clays or silts characteristically have poor internal drainage. The problem also occurs in soils that have high water tables or are underlain by hardpans. Because of the danger of serious root damage if rainfall is high during the growing season, tobacco usually is not planted on such soils. If you must plant and irrigate tobacco on a soil with poor internal drainage, make lighter applications of water than are recommended for other soils. Light applications reduce the danger of waterlogging from subsequent rains.

PRELIMINARY STEPS

Before you invest in an irrigation system, be reasonably sure that irrigation will be profitable. Check on—

- *Water supply.*—Be sure there is enough water for the project you have in mind, and that it is not contaminated in any way that would make it unsuitable for irrigation.

- *Well drilling.*—Drilling and casing are expensive. Perhaps you should have a test boring made to find out whether drilling a well is justified.

- *System design.*—The system should be primarily designed for the field, the crop, the water supply, and the labor.

- *Soil type and topography.*—Construct farm ponds or ground-water reservoirs only on sites where tests have shown that soil type and topography are favorable. Also, have soil tested on the field that is to be irrigated; some soils are not suitable for irrigation.

In addition, thoroughly investigate the legality of withdrawing water from any source for irrigation purposes.

GENERAL GUIDES

It is not possible to give specific instructions for irrigating tobacco; there is too much variation in rainfall pattern, soil type, temperature, and other factors that effect moisture availability and rates at which plants use water. However, there are general guides that are helpful in making the important decisions—when to irrigate and how much water to apply.

Following are instructions on how to use—

- Stage of growth as a guide.
- Soil moisture as a guide.
- Soil texture as a guide.

Stage of Growth as a Guide

The stage of growth can serve as a guide to irrigation because the moisture needs of the plant are different at various stages of growth. The two times in the growth of the plant when moisture is most necessary are at transplanting time and during the period between the knee-high and full-bloom stages of growth.

Transplanting Time

Plant survival is the main concern at transplanting time; irrigation probably will be uneconomical if plants can survive without it. If rain does not come at the proper time to supply soil moisture during

this period, irrigation water may be applied—

- The day before transplanting, to prevent clod or crust formation.

- The morning after transplanting, to avoid leaf bruising—leaves generally wilt during hot, dry periods following transplanting.

- Before and after transplanting—often, both methods can be used to advantage during dry periods.

Water applications at transplanting time should be light—¼ to ½ inch for sandy soils and 1 to 1½ inches for fine-textured soils.

Transplanting Time to Knee-High Stage

From transplanting time to the knee-high stage, visible signs of wilt can occur without lowering the yield or affecting the quality of the crop at harvest. Irrigating probably will be uneconomical unless there are signs of rather severe stress. If the water supply is limited, this is the time to conserve water, rather than during the next period of plant growth. If soil moisture reaches such a low level that plants are obviously suffering, however, irrigation water should be applied. This also should be a light application—about the same as that recommended for irrigating at transplanting time.

Knee-High to Full-Bloom Stage

The most critical period in the growth of the crop is between the knee-high and full-bloom stages of growth. Plants develop rapidly then, and their demand for water is high. During this stage of growth, do not wait for visible signs of wilt to occur before you apply water—use soil moisture or soil texture as a guide for determining when you should irrigate.

After Full Bloom

Slight wilting after the full-bloom stage should not be taken as an indication that you should irrigate. If it appears that an irrigation is necessary to prevent severe wilting use water conservatively—apply only about as much as is recommended above for irrigating at transplanting time.

EXPLANATION OF TERMS

To make the discussion that follows more clear, these terms are explained:

Field capacity.—The highest amount of moisture the soil can hold under conditions of free drainage, after excess water has drained away following a rain or irrigation that has wet the whole soil.

Available water.—The part of the water in the soil that can be taken up by plants at rates significant to their growth; often expressed in inches of water per foot depth of soil. A medium-textured soil normally stores about 2 inches of usable water per foot depth of soil; sandy soils store less, fine textured soils store more.

Evapotranspiration.—The combination of surface evaporation and plant transpiration by which available water is lost.

Soil Moisture as a Guide

Between the knee-high and full-bloom stages of growth, irrigation usually should start when about half of the available water has been removed. There are a number of methods of estimating when soil moisture falls to this level. Some

of them require tests by trained persons with special equipment. Two methods sufficiently accurate for on-the-farm use are:

1. Squeezing a soil sample in the hand and observing its physical condition after squeezing.

2. Keeping a day-by-day record of estimated water use and of water added to the soil.

Hand-Test Method

Squeezing soil in the hand is a somewhat crude method of estimating soil moisture, but it is widely used and farmers' experience shows it is a worthwhile method. If you wish to follow this method, take a handful of soil from a depth of 6 to 9 inches (fig. 2), squeeze it firmly, and observe its physical condition (fig. 3). Soil moisture probably is at about the 50-percent level or less when—

- Moderately coarse-textured soils (sands and loamy sands) do not remain compacted when pressure of the hand is released.

- Medium-textured soils (sandy loams) form a ball, but the ball begins to break up when the hand is opened.

- Medium-fine and fine-textured soils (loams and clay loams) form a stable and slightly pliable ball.

Recordkeeping Method

A day-by-day record of the soil moisture supply will help in estimating the balance of available water. Accuracy of the method depends on knowledge of the water-

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Figure 2.—**Take soil samples from a depth of 6 to 9 inches for the hand-test method of estimating soil moisture.**

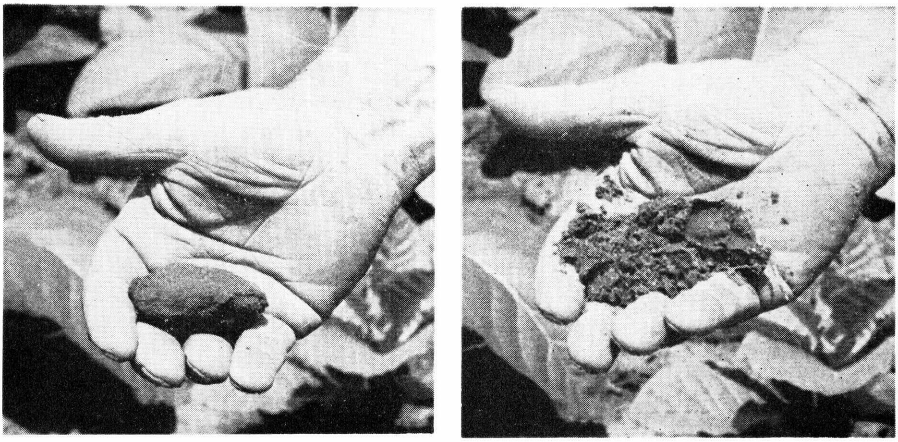

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***Figure 3.*—The sample of loamy sand soil at left remains in a ball after being squeezed—an indication that irrigation is not needed. A sample of the same type of soil (right) falls apart in the hand after being squeezed—an indication that irrigation is needed.**

holding capacity of the soil, the daily water loss, and moisture added to the soil by rainfall or by irrigation.

Approximate available-water capacities of different soil types are:

SOIL TEXTURE:	*Available water (inches per foot)*
Sands	0.7 to 1.0
Loamy sands	1.0 to 1.3
Sandy loams	1.3 to 2.3
Silt and clay loams	1.5 to 2.5

Evapotranspiration rates for tobacco crops usually range from 0.11 to 0.18 inch of water per day. The rate may be somewhat higher in the most southerly tobacco-growing areas, and slightly lower in the most northerly areas. Moisture loss from soil and plants averages about 0.15 inch a day on medium-textured soils. Obtain more accurate information on evapotranspiration rates from your Soil Conservation Service technician.

A simple homemade record form is satisfactory for keeping the balance-of-water record. Table 1 is such a record.

TABLE 1.—*Example of recordkeeping to determine when to irrigate tobacco growing in a soil with an available-water capacity of 1.6 inches per foot*

Date	Evapotranspiration	Rainfall	Irrigation	Balance
July:	*Inches*	*Inches*	*Inches*	*Inches*
10			2.50	2.40
11	0.13			2.27
12	.15			2.12
13	.18			1.94
14	.17			1.74
15	.17			1.57
16	.18			1.39
17	.13	0.25		1.47
18	.15			1.32
19	.13			1.19
20	.15		1.50	2.40

In table 1, evapotranspiration data are inserted only to illustrate how the record is kept; entries in your own record should be based on information from the Soil Conservation Service office in your county. The best way to determine rainfall is to set up rainfall gages close to the tobacco field (fig. 4). Inexpensive gages are available. Rainfall data reported by newspapers or on radio or TV broadcasts are not satisfactory for this purpose. Fields located short distances apart

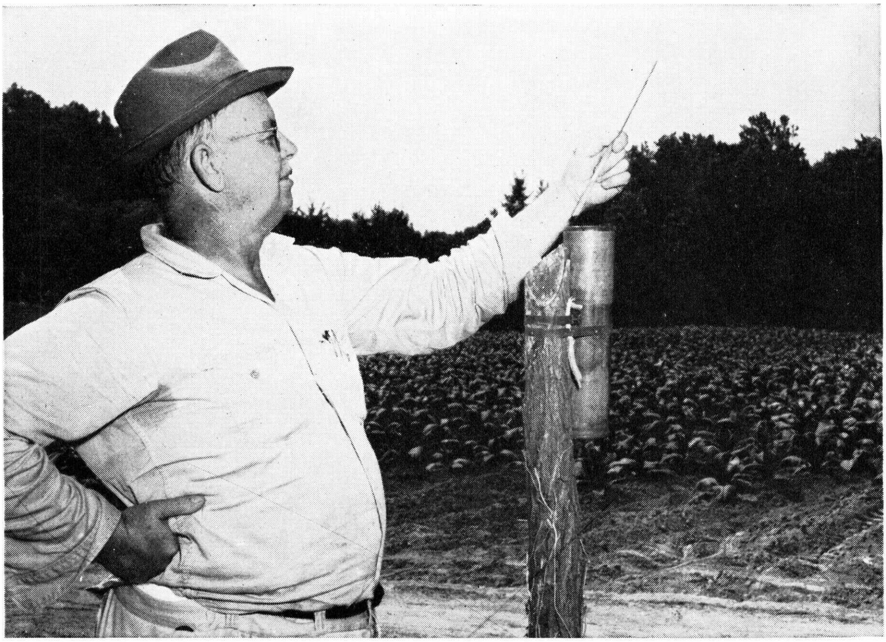

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Figure 4.—**To accurately measure rain that falls on the field, set up a rainfall gage in or near the field.**

often receive different amounts of rainfall.

The record illustrated in table 1 was started after the soil had been filled to field capacity by an irrigation. Thus, the first entry in the record was the irrigation. It was slightly more than the available water capacity of the soil to a depth of 18 inches. However, the 0.10-inch excess is disregarded because it is assumed that some water runs off or seeps beyond the root zone of tobacco plants.

From July 10 through July 16, the crop and field lost various amounts of water. These were subtracted from the balance of available moisture. On July 17, 0.13 inch of water was lost and 0.25 inch of rain fell, leaving a net gain of 0.08 inch. This gain was added to the balance of available moisture. By July 19, the balance of available water had fallen to about one-half the soil's capacity. On July 20, another 0.15 inch was lost and an irrigation of 1.50 inches was applied to restore the balance to field capacity. Actually, 1.36 inches was required to restore field capacity; the extra 0.14 inch was applied to compensate for water loss.

Soil Texture as a Guide

Soil texture can also be used as an irrigation guide from the knee-high to full-bloom stage of growth to prevent moisture deficiency.

Table 2 is a general guide for amount and frequency of water application for soils that range in texture from sandy to silt and clay loams. This guide is based on knowledge of how rapidly the moisture level falls in soils of various textures.

TABLE 2.—*A guide to irrigation, based on water-holding characteristics of soils of various textures*

Soil texture	Interval between irrigations [1]	Amount of water to apply [2]
	Days	*Inches*
Sands	3 to 7	0.50 to 0.75
Loamy sands	4 to 9	.75 to 1.00
Sandy loams	6 to 16	1.00 to 1.75
Silt and clay loams	7 to 17	1.10 to 1.85

[1] Time required for about half the available water to be lost if there is no rain. If there is a rain, compare the amount of rainfall with figures in the right column to decide how long to postpone the next irrigation.

[2] Approximate amount of water required to restore root zone to field capacity after about half the available water has been lost (with allowances for evaporation and other unavoidable loss).

USING THE GUIDES

The choice of a method to use in determining when and how much to irrigate should be based on your personal preference and experience. If you have no preference or experience, the following are suggested until you learn which methods are best suited to your farm:

- During the early and late stages of growth, use plant condition as a guide. Don't irrigate until the plants show signs of wilt, then irrigate lightly.

- Between the knee-high and full-bloom stages of growth, anticipate moisture needs. Irrigate before the plant suffers from lack of moisture. Follow one of the methods described in this leaflet for using the soil as a guide to irrigation.

APPLICATION RATES

Generally, coarse-textured soils take up water rapidly, and fine-textured soils take up water slowly.

Water should not be applied at a faster rate than the soil can absorb it (fig. 5). It is usually safe to apply water within the following rate

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***Figure 5.*—Irrigation water is being applied in this field faster than the soil can absorb it. Result: Runoff water is starting erosion.**

ranges for the different soil textures:

Soil texture:	Application rate (inch per hour)
Sands	0.60 to 1.00
Loamy sands	.40 to .70
Sandy loams	.30 to .50
Silt or clay loams	.20 to .35

If rates recommended by your Soil Conservation Service technician or other specialist familiar with conditions in your area are different, follow recommendations from the local source. If there is any doubt about whether the rate is right for your soil, adjust the rate downward—it is better to take more time than to risk soil puddling, water loss, and erosion by exceeding soil intake rates.

WATER SUPPLY

Do not plan for an irrigation system unless you are sure of a dependable water supply. Clean and clear water is preferable, and the source should be near the area to be irrigated (fig. 6). Water should not be contaminated by harmful plant-disease organisms or contain damaging concentrations of minerals such as chlorides or sulfur. A competent person should check the available water supply for quality and quantity.

Farm ponds and ground-water reservoirs are the sources of water most often used for tobacco irrigation. Sites for ponds and reservoirs must be carefully selected. The dam for a farm pond should be located on a good dam site where it will collect water from an adequate watershed. Ground-water reservoirs are successful only in certain types of soils that have a water table near the surface (fig. 7). Obtain advice from the Soil Conservation Service or the agricultural Extension Service before you construct a pond or ground-water reservoir.

Although wells usually are expensive, they are increasing in popular-

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***Figure 6.*—This field is ideally located with respect to source of irrigation water—the distance from field to water is about 200 feet, and the lift is about 3 feet.**

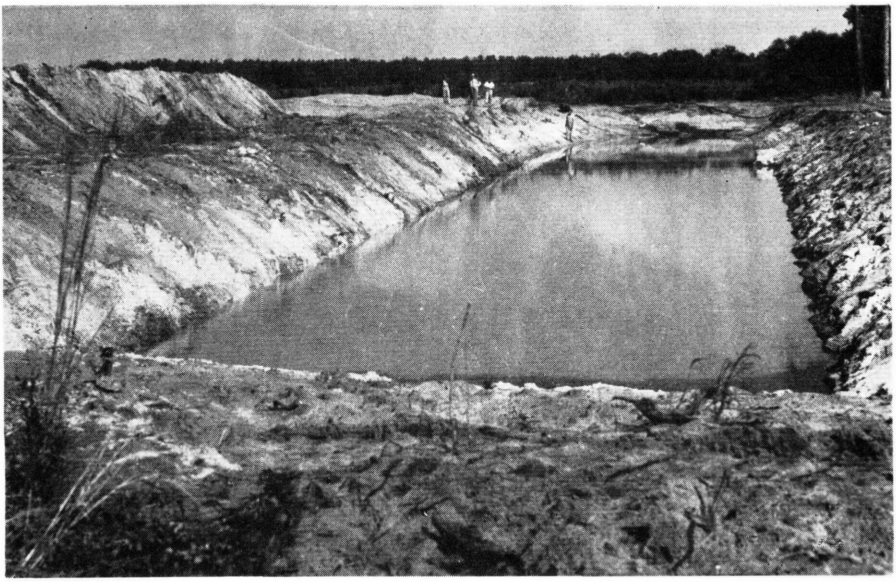

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Figure 7.—**Ground-water reservoirs are the most satisfactory source of irrigation water in some areas. They are successful, however, only in certain types of soil that have a high water table.**

ity for irrigation purposes because they are generally more dependable than farm ponds during long dry periods.

Some States have legislation restricting the use of natural water supplies. Therefore, if there is any doubt as to the legality of withdrawal from any water supply, obtain legal counsel before you irrigate from the supply.

IRRIGATION SYSTEMS

An irrigation system should be specifically designed for each irrigation project. The engineer who designs your system will consider such factors as water supply, type of soil, crop to be grown, distance from water source to the edge of the field to be irrigated, difference in elevation between the field and the water source, number of acres to be irrigated, shape of field, source of power for pumping, labor available, and your financial status.

COSTS

Most farmers who irrigate tobacco use the sprinkler method of irrigation.[1] The following estimates are for that method, and are based on the most recent (1960) information available.

Initial Investment

The initial investment in irrigation is for establishing a source of water and buying a distribution system.

Streams and lakes are the sources of cheapest water. Wells usually are the sources of most expensive

[1] For more information on the sprinkler method of irrigation, see USDA Leaflet 476, "Sprinkler Irrigation."

water because of drilling costs. The cost of farm ponds and ground-water reservoirs, or "dug ponds," usually is less than the cost of wells.

Consult with specialists for estimates on the cost of developing a source that will supply high-quality water in the amount you need.

Initial costs of sprinkler-irrigation systems vary. Systems have been installed for less than $100 per acre, but this probably is the least you should expect a system to cost. If there are problems such as lifting water a great height or pumping it a great distance from the source to the field, the cost may be three or four times as much. The per-acre cost is less for big fields than for small ones.

Have specialists with the Soil Conservation Service or the agricultural Extension Service in your State help you with cost estimates before you buy a system.

Operation and Maintenance

Operating and maintenance costs include the expense of pumping, labor, and repairs. Your equipment dealer can give you an estimate of pumping and repair expenses. You probably can make a reasonably accurate estimate of labor costs.

Costs can be controlled to some extent by staying within the designed limitations of the system. It is also possible to economize by having an irrigation plan that will limit pumping hours to make the best use of labor.

Expenses of pumping, labor, and repairs are variable costs. That is, they are different from year to year, and from farm to farm. In addition to variable costs, the annual expense of the system includes fixed costs—depreciation, taxes, insurance, and interest on the investment.

Growth Through Agricultural Progress

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